Agenda

I. Introductions (30 minutes)
- Welcome
- Review: Stakeholder Homework & Prioritization of Discussion Topics
- SC PSC Order No. 2020-832 2021 IRP Update Requirements
- Timing of Commission Requirements for upcoming IRPs

II. Model Selection (60 min)
- Review: Stakeholder Input, Proposed Models, and Criteria
- Explain Model Scorecard Methodology and Define Criteria on Scorecard
- Present Model Evaluation and Rankings
- *Discussion*

<15 minute break>

III. Review Modified 2020 IRP Filing (30 min)
- Review: Act No. 62 Evaluation Factors
- Preferred Plan Selection Criteria
- *Discussion*

IV. 2021 IRP Update Scenario Modeling & Inputs (30 min)
- Gas Price Assumptions
- DSM Assumptions
- CO2 Price Assumptions
- *Discussion*

V. 2021 IRP Update Resource Plan Modeling & Inputs (60 min)
- New Resource Capital Costs & Escalation Rates
- PPA Costs and Assumptions
- Mini-Max vs. Other Risk Metrics
- Modeling Existing Candidate Resource Plans
- Model Additional Low Carbon Plan
- *Discussion*

<15 minute break>

VI. Retirement Analysis (20 min)
- Review: Short-Term Action Plan
- Status of DESC's Retirement Analysis and Transmission Impact Analysis Request

VII. Solar Winter Capacity (20 min)
- DESC's Understanding of the 2021 IRP Update Requirements
- Explanation of Reliability Measurement vs. Resource Compensation Rate for PV Solar Capacity

VIII. Homework for Session III and Discussion (20 min)
- Overview of Session II Homework
- *Discussion*

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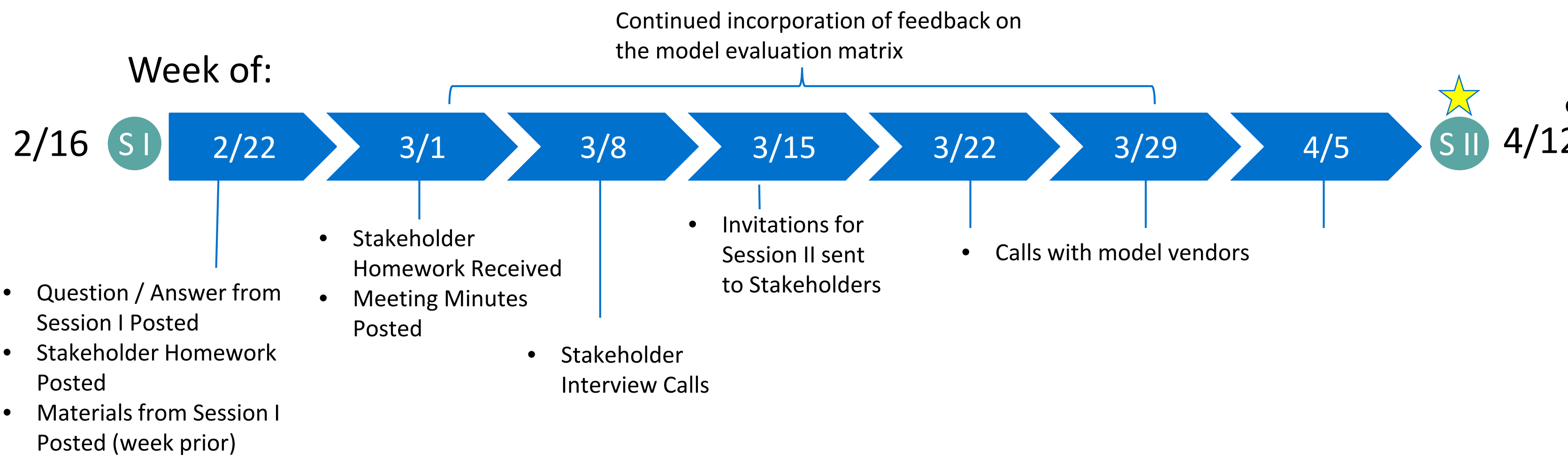
DESC IRP Stakeholder Advisory Group Meeting #2

I. Meeting Agenda and Introductions

I. Introductions

- Welcome
- Review: Stakeholder Homework & Prioritization of Discussion Topics
- SC PSC Order No. 2020-832 2021 IRP Update Requirements
- Timing of Commission Requirements for upcoming IRPs

Where are we in the process?



Stakeholder feedback has been received and incorporated into the agenda and content for today's meeting

- Feedback on the meeting process and possible solutions have been discussed by the team
- Meeting topics have been added to the agenda, and sequenced according to stakeholder feedback
- DESC has evaluated both existing and stakeholder-proposed models and assessed them against the existing and new model requirements

Advisory Group Feedback on Meeting Process

Advisory Group Feedback	DESC Response
1. Suggest participants should instead "raise hands" and ask questions live, and be able to unmute themselves.	Providing questions in writing ensures that all questions are answered and that they are answered by those best suited to respond. We apologize, as the remote process makes facilitating Q&A complicated. In our best effort to welcome live questions, DESC gives Stakeholders opportunities to ask live follow-up questions. In addition, during select sessions, including today's final discussion on model selection, we will employ a "raise hand" and live question approach.
2. Request meeting materials be made available ahead of the meeting.	The team develops the meeting materials as quickly as possible, and will provide these materials as soon as they are completed.
3. Requests employment of an information sharing process where Stakeholders can request background materials and studies used by DESC.	A formal information sharing procedure is beyond the scope of the Advisory Group process. The website allows for questions to be submitted to the DESC team and answers may include additional documents where warranted.
4. Ask that the EE Advisory Group take up not only development of MPS using a similar stakeholder process, but that the Advisory Group also work to recommendations to meet 1% levels outside of examples provided by Dr. Hill.	This recommendation has been shared with the DSM Advisory Group.
5. Requests the opportunity to offer presentations on topics where there is disagreement and/or that are not being covered in DESC's agenda.	DESC has requested and will continue to request Stakeholder feedback on the agenda for the Advisory Working Group. Please notify us of topics of interest that should be raised, we will endeavor to address them in future meeting agendas.

Advisory Group Feedback on Meeting Topic Sequencing

Incorporation of Stakeholder Feedback on Meeting Topics

- Stakeholders felt that homework could have been better specified because all topics are of “high” importance
- Stakeholders suggested a sequencing of topics by their influence on other subsequent issues, or by the amount of time needed to address them

Topic	Response 1 (H/M/L)	Response 2 (Order)	Response 3 (Rank)
Transparency of IRP analysis	High	First	3
Model selection for future IRP work	High	First	7
Generator retirement analysis	High	Second	1
Analysis of solar PV winter capacity value	Medium	*N/A*	5
Risk metrics & industry best practices	Medium	Third	8
CO2 and commodity price scenarios	Low	Last	4
Candidate resource costs	Medium	Last	2
Updates to the DSM portfolio & DSM cases	Medium	*N/A*	6

Advisory Group Feedback on Evaluated Models and Model Criteria

Incorporation of Stakeholder Feedback on the Model Matrix

- Stakeholders have added models to the evaluation list and added evaluation criteria
- DESC has utilized the feedback and has expanded the model evaluation process. Since Session I, the team has examined the additional model suggestions, and has incorporated new Stakeholder criteria against which candidate models are evaluated.
- A more in-depth discussion on the model evaluation process is to follow

Stakeholders evaluation criteria added

Session I Scorecard

Model	Developer	Model Functionality and Capabilities							Model Transparency / Stakeholder			
		Portfolio Capacity Expansion / Retirement Optimization	*Emission Limit Constraints*	*Chronological Dispatch and Optimization*	*Long-term Cost Accounting and End Effects*	*Advanced Storage Logic – Pairing, Daily/ Seasonal Cycling*	*Operational Constraints – Start Costs, Min up/down Times*	*Flexible, Time-indexed Cost and Growth Escalators*	*Manual Availability*	*Third-party License at Reasonable Cost*	*Easy Access to Input/ Outputs*	*Intuitive User Interface*
PLEXOS	Energy Exemplar											
Aurora	Energy Exemplar											
PowerSIMM	Ascend Analytics											
EGEAS	EPRI											
SERVM	Astrape											
EnCompass	Anchor Power Solutions											
Strategist	ABB											
PROMOD	ABB											
PROSYM / PAR	ABB											
UPLAN	LCG											
WIS:dom-P	Vibrant Clean Energy											

Stakeholders model suggestions evaluated

Order requirements are staged over forthcoming IRP years

Topic Areas	2020	2021	2022	2023
Natural Gas	Re-run production cost modeling using the AEO low, reference, and high gas prices		Use a “wide but plausible” range of gas price projections from a public, credible source	
DSM	Consider 1% savings in ‘22, ‘23, and ’24, and conduct rapid assessment of cost-effectiveness and achievability. Include results and action steps to complete evaluation of the cost-effectiveness and achievability of DSM portfolios savings ranging from 1% to 2%		Evaluate the cost-effectiveness and achievability of four levels of savings: 1.25%, 1.5%, 1.75%, and 2%. Consider substantive changes to the existing portfolio. Include new candidate resource plans including DSM and purchased power as options	Incorporate potential study findings in 2023 plus work with stakeholders to iterate portfolios with incentives and best practices to achieve modeled levels of DSM savings
Purchased Power	Use flexible **solar PPA** cost assumptions and model 400MW flexible Solar PPAs starting 2023 w/ 20-year prices: $34, $36, and $38.94/MWh. **Storage PPAs** - use NREL ATB's low storage costs (capital and fixed O&M)		Include additional candidate resource plans including DSM and purchased power in candidate resource plans and evaluated across multiple scenarios	
Solar PV	Assume integration costs of $0.96 / MWh for solar PV, until there’s Commission-approved method to calculate it			
ICT	Use industry accepted ICT capital cost assumptions			
CO_2 Prices	Re-run production cost model using AEO High CO_2		Use “wide but plausible” zero/M/H CO_2 cost projections from AEO	
Peaking reserve margins			Include resource plans to meet full peaking reserve margin. Find what resources best meet the peaking increment	
Risk-adjusted metrics			Consider, with stakeholder input, use of more sophisticated risk-adjusted metrics (natural gas price risk, carbon price risk, load forecast risk)	
Coal Retirement			Incorporate the conclusions from the comprehensive coal retirement analysis called for in this Order	
Action Plans	3-year action plan with steps to implement the IRP			

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Not all requirements are Included in the 2021 IRP Update

Topic Areas	2020	2021	2022
Modeling Software			Implement capacity expansion software with input from stakeholders. Software must meet transparency requirements. Avail inputs and outputs, assumptions, post-processing sheets, and the model manual
Required Resource Plans	Include analysis and comparison of all candidate resource plans using simple quantitative risk metrics (cost ranges and minimax regret score)		Consider diversity of generation supply, and propose candidate resource plans designed to further diversify. Include “contribution to diversity supply” in the evaluation of candidate resource plans
	Include more candidate resource plans that deploy renewables (RP7-A and RP7-B). In 2021, keep quantitative risk metrics from 2020 and update to latest data		
ITC Assumptions	Storage PPAs use the same 22% ITC safe harbor assumptions employed for PV PPAs		
Resource Cost Assumptions	Two different escalation rates implemented incorrectly - correct the error		
Resource Performance Assumptions	Correct the incremental flexible solar PPA capacity value assumptions to the existing system penetration level of incremental flexible solar PV		
	Include recent generator performance data (e.g. forced outage rate). Include storm and hurricane-related outage reporting		
Load Forecast Assumptions			Develop a wide range of load forecasts. Cost modeling capture each plan's capabilities to adapt to load that diverges from base forecast
Stakeholder Process		Report on Stakeholders. Semi-annual updates	Negotiate discounted, licensing fee that permits intervenors to perform modeling. Absorb the cost
State and Federal Regulations	Include more analysis how environmental regulations affect generation units and resource choices		
Rate and Bill Impacts	Calculate the rate and bill impacts of portfolios, rather than just a levelized NPV of revenue requirements		

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Summary of requirements for 2021 DESC IRP Update

	Mod. 2020	Scenario Inputs
Natural Gas	✓	Re-run production cost modeling using the AEO low, reference, and high gas prices. **Updated to latest AEO.**
DSM	✓	Consider 1% savings in ‘22, ‘23, and ’24, and conduct rapid assessment of cost-effectiveness and achievability. Include results and action steps to complete evaluation of the cost-effectiveness and achievability of DSM portfolios savings ranging from 1% to 2%
Purchased Power	✓	Use flexible solar PPA cost assumptions and model 400MW flexible Solar PPAs starting 2023 w/ 20-year prices: $34, $36, and $38.94/MWh. Storage PPAs - use NREL ATB's low storage costs (capital and fixed O&M)
Solar PV	✓	Assume integration costs of $0.96 / MWh for solar PV, until there’s Commission-approved method to calculate it
ICT	✓	Use industry accepted ICT capital cost assumptions
CO_2 Prices	✓	Re-run production cost model using the AEO’s High CO_2 case
Action Plans	✓	3-year action plan with steps to implement the IRP In all future IRPs
		Resource Plan Inputs
Req. Resource Plans	✓	Include more candidate resource plans that deploy renewables (RP7-A and RP7-B). In 2021, use same simple quantitative risk metrics from 2020 but update to the latest data. **DESC may add at least one additional lower carbon option to the 2021 IRP Update.**
ITC Assumptions	✓	Storage PPAs use the same 22% ITC safe harbor assumptions employed for PV PPAs
Resource Cost Assumptions	✓	Two different escalation rates implemented incorrectly - correct the error
Resource Performance Assumptions	✓	Correct the incremental flexible solar PPA capacity value assumptions to the existing system penetration level of incremental flexible solar PV
Rate and Bill Impacts	✓	Calculate the rate and bill impacts of portfolios, rather than just a levelized NPV of revenue requirements
Stakeholder Process	✓	Create a stakeholder advisory process and continue to provide semi-annual updates

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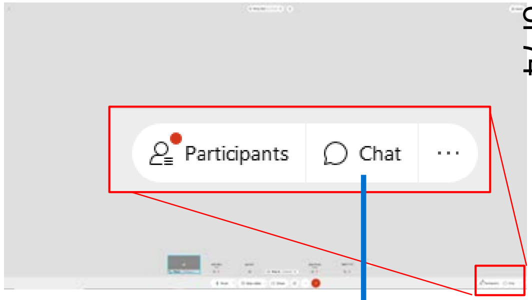
Q&A

- Microphones will be muted during presentations; we will open them when addressing questions at end of each section
- During presentations, questions can be submitted via the chat function
  - Only questions submitted in writing will be answered during live Working Group Sessions
- Each questioner will be allowed one follow-up question before they yield the floor to the next questioner
  - Please don't ask multiple questions in one question
  - If time permits and all questioners are answered, we will come back for additional questions
- All Q&As will be responded to in writing and placed on the web page:
  - https://www.DESC-IRP-Stakeholder-Group.com

Look for the chat function in the bottom right hand corner of the WebEx screen



Please send all questions via chat to Pat Augustine

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DESC IRP Stakeholder Advisory Group Meeting #2

II. Model Selection

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II. Model Selection

- Review: Stakeholder Input, Proposed Models, and Criteria
- Explain Model Scorecard Methodology and Define Criteria on Scorecard
- Present Model Evaluation and Rankings
- *Discussion*

Overview of Stakeholder feedback on model selection

- As part of Session I DESC requested that Stakeholders provide feedback on the model selection criteria and suggest additional models for evaluation as alternatives to PLEXOS
- A small number of stakeholders provided feedback by suggesting additional criteria, suggesting additional models or providing feedback on the function of specific models
- CRA followed up with each stakeholder that provided feedback on model criteria for a 45 minute call
- On these calls, CRA staff walked through the suggested criteria and clarified the feedback from the stakeholders to confirm our understanding and discuss the comments provided
- No Stakeholders responded that PLEXOS was incapable of functions required by the Commission, however there were questions raised about the model's transparency and whether the project-based license offered by the vendor would meet intervenor needs

Review of Stakeholder Responses

- Stakeholders suggested additional models to be reviewed as potential replacements for PLEXOS
  - GridPath – Blue Marble Analytics
  - E7 – ABB
  - Resource Planning Model – NREL
  - Resolve – E3
  - GridSim – The Brattle Group

- Beyond a model's capabilities, Stakeholders responded that its not just what a model can do but what DESC will do with it in the 2022 and future IRPs
  - Renewable input assumptions and reliability impacts
  - Modeling of battery and pumped storage
  - Decarbonization approaches
  - How the model outputs will be used further analysis

Review of Stakeholder Comments on Model Selection Criteria

- Stakeholders provided feedback on model function as well as transparency and licensing options, these were incorporated into the evaluation of candidate models

Model Functionality and Capabilities

- Calculates revenue requirements and economic carrying charges
- Ability to dispatch to load
- Model operating reserves, curtailment, and other system flexibility measures (storage, DR)
- Customize the number stochastic draws
- Optimize individual service territories
- Use different market price forecasts for different scenarios
- Reasonable capacity expansion run times
- Carbon policy representation
- Model renewable generation profiles with geographic diversity
- Accurate modeling of pumped storage
- Modeling of coal retirements and related transmission considerations
- "Single-step" methodology for capacity expansion modeling
- Easily perform annual investment periods
- Time horizon modeling capabilities

Model Transparency / Licensing

- Ability to license on a project (less than annual) basis
- License agreement permits intervenors to use the license in the manner that "works best for each"
- Ability to review objective/NPV and customize MIP gap
- Ease of exporting inputs and outputs with no text files
- Automatic reporting
- Vendor provides support and regular updates to software
- Ability to run model independently without assistance from vendor

CRA evaluated models against two "scorecards"

- Commission criteria are "need-to-haves"
  - Reflect the criteria described by the Commission in the Dec 23 Order
  - Represent functions that are required for selection by DESC
- Stakeholder criteria are "nice-to-haves"
  - Used to distinguish between models that score similarly on Commission criteria

The “Commission scorecard” was developed based on the requirements cited in the order

Commission Criteria	Definition	Commission Scorecard Category
Ability to optimize emission limits	Model can explicitly reflect different types (e.g., mass vs. rate) of emissions and clean energy targets	*Emission Limit Constraints*
Capable of optimizing a broad range of retirement dates	Model optimization capable of selecting between different retirement dates for existing units when performing capacity expansion	*Portfolio Capacity Expansion / Retirement Optimization*
Captures accurate long-term costs of different lives alternatives	Model accurately reflects full cost of units built later in the modeling period	*Long-term Cost Accounting and End Effects*
Accepts a non-linear escalation rate and negative escalation rates	Model accepts a wide range of growth and escalation input assumptions that are indexed to time	*Flexible, Time-indexed Cost and Growth Escalators*
Chronological model instead of using a load duration curve simplification for better renewable and storage modeling	Model solves or dispatches to hours (or smaller intervals) in order and does not rely on aggregation of hours into representative blocks	*Chronological Dispatch and Optimization*
Storage logic can handle more than once a day charging and discharging as well as long term storage modeling over weeks, seasons	Model solves for storage behavior as opposed to relying on pre-defined charge / discharge assumptions and allows for short- and long-term optimization periods	*Advanced Storage Logic – Pairing, Daily/ Seasonal Cycling*
Ability to tie storage charging to a specific technology	Modeled storage resources can be paired with other generators reflecting impacts on cost, charging, and operation	*Advanced Storage Logic – Pairing, Daily/ Seasonal Cycling*
Ability to accurately model economic reserve shutdowns (start-up cost, min down time, run time)	Dispatch characteristics including ramp rates, minimum run times, and start-up costs of modeled units are accurately reflected in simulation	*Operational Constraints – Start Costs, Min up/down Times*
Availability of manual to stakeholders	Stakeholders to DESC IRPs process will have access to manual if model is selected	*Manual Availability*
Provide transparency into modeling; access to software inputs, outputs	Model allows stakeholder visibility into all inputs, outputs, and settings with requiring vendor	*Easy Access to Input/ Outputs*
Licenses available at reasonable cost	Model includes project-based or discounted license for Stakeholders to DESC IRP	*Third-party License at Reasonable Cost*

Defining Criteria – what is required and what is "better"?

Criteria	Min Requirement	Better if:
Ability to optimize emission limits	• Model can reflect RPS & Emissions requirements	• Targets can be rates or caps • Modeled units can be part of multiple overlapping programs • Model allows Alternative Compliance Payment or price controls
Capable of optimizing a broad range of retirement dates	• Model capable of selecting retirements as part of capacity expansion optimization	• Model can reflect different fixed cost schedules for different retirement dates
Captures accurate long-term costs of different lives alternatives	• Model evaluates long-term resource costs beyond modeling horizon as part of optimization	• Model also incorporates revenue requirement details
Accepts a non-linear escalation rate and negative escalation rates	• Model can reflect time-indexed inputs reflected by the user with individual inputs for every time series	
Chronological model instead of using a load duration curve simplification for better renewable and storage modeling	• Portfolio optimization of the model solves in at least an hourly chronological order	• Model allows for sub-hourly operation • Chronology is maintained across capacity expansion and portfolio analysis
Storage logic can handle more than once a day charging and discharging as well as long term storage modeling over weeks, seasons	• Model optimizes storage behavior as opposed to relying on user-input charge / discharge cycles • Model can accommodate long-term pumped storage resources and batteries	• User can select the optimization period for different resources • User can select optimization target for storage (e.g. price vs. demand)
Ability to tie storage charging to a specific technology	• Model allows explicit pairing of storage resource with other units in capacity expansion model	• Model co-optimizes paired units in portfolio dispatch

Defining Criteria – what is required and what is "better"?

Criteria	Min Requirement	Better if:
Ability to accurately model economic reserve shutdowns (start-up cost, min down time, run time)	• Model reflects start costs, min-up and down times	
Availability of manual to stakeholders	• Model help files are available to intervenors	• Model manual is standalone document • Documentation can be shared without a license
Provide transparency into modeling; access to software inputs, outputs	• Model allows export of inputs, outputs	• Model allows export of settings • Format of outputs is easy to use (Excel)
Licenses available at reasonable cost	• Discounted license available for intervenors that allows review and comment on all inputs, outputs, and settings	• License allows more users • License includes solver

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Some Stakeholder Criteria were Evaluated as Part of the Commission Criteria

Criteria	Definition	Alignment with Commission Criteria
Model reflects operating reserves, curtailment, and other system flexibility measures (storage, DR)	• Model accurately reflects reserve constraints of different units • Model “solves” storage to reflect system conditions rather than relies on a user-provided charge / discharge cycle • Model can reflect changes to regional constructs that affect curtailment or solar integration	Evaluated in “Advanced Storage Logic – Pairing, Daily/ Seasonal Cycling” and “Operational Constraints – Start Costs, Min up/down Times” categories
Accurate modeling of pump storage	• Model “solves” storage to reflect system conditions rather than relies on a user-provided charge / discharge cycle	Evaluated in “Advanced Storage Logic – Pairing, Daily/ Seasonal Cycling”
Modeling of Coal Retirements and Related Transmission Considerations	• Model should be able to select retirement dates as part of optimization. • Model should reflect transmission impacts of large thermal unit retirements.	Evaluated in “Portfolio Capacity Expansion / Retirement Optimization”
Ability to License on a Project (less than Annual) Basis	• Model can be licenses for specific project or limited time period.	Evaluated in “Third-party License at Reasonable Cost”
Time Horizon Modeling Capabilities	• Model solves entire forecast period and does not rely on averaged or carried-forward values in outer years.	Evaluated in “Long term Cost Accounting and End effects”
Carbon Policy Representation	• Model has flexible representation of CO2 constraints that allows for accurate simulation of different policy approaches.	Evaluated in “Emission Limit Constraints”
Easy of Exporting Inputs and Outputs with no Text Files	• Model should report in excel or similar structured format. • Model should be able to export all inputs and user settings as well as modeled outputs.	Evaluated in “Easy Access to Inputs / Outputs”
Automatic Reporting	• Model should report inputs and outputs without requiring vendor help or lengthy reruns.	Evaluated in “Easy Access to Inputs / Outputs”
Use Different Market Price Forecasts for Different Scenarios	• The model should have the capability to reflect different views of market and commodity prices as part of the scenario analysis.	Evaluated in “Flexible, Time-indexed Cost and Growth Escalators”
Ability to Review Objective/NPV and Customize MIP Gap	• Model objectives and convergence gap should be transparent and provide user with customization options.	Evaluated in “Easy Access to Inputs / Outputs”
Calculates Revenue Requirements and Economic Carrying Charges	• Model selected should accurately capture end effects and full life of assets.	Evaluated in “Long term Cost Accounting and End effects”
Easily Perform Annual Investment Periods	• Model is able to practically run or optimize every year in the forecast.	Evaluated in initial screening criteria

Others were considered as part of the "Stakeholder scorecard"

Criteria	Definition	On Stakeholder Scorecard
Vendor Provides Support and Regular Updates to Software	• Model has continued technical support from vendor and training is available to new users.	Yes
Ability to Dispatch to Load	• Due to non-RTO nature of region, model must not rely on prices to simulate dispatch.	Yes
Customize Number of Stochastic Draws	• Model should allow for stochastic analysis using a statistically significant number of draws.	Yes
Optimize Individual Service Territory alone	• Model should not required parameterization of entire Eastern Interconnect or US to run the SE region.	Yes
Reasonable Capacity Expansion Run Times	• The model should take no more than about a day to solve	Yes
Ability to Run Model Independently without Assistance from Vendor	• Model user should be able to set inputs without requiring updates from the vendor.	Yes
License Agreement permits Intervenors to use the license in the manner that "works best for each"	• Model license terms should be consistent with envisioned use case by Stakeholders to DESC IRP process, including use by consultants to intervenors in the IRP	Yes
Model Renewable Generation Profiles with Geographic Diversity	• Model allows for granular representation of renewable resource to reflect differences in resource quality / geography.	Yes

Questions? Please use the Chat function

Approach to Evaluation & Standard

- DESC is already on the path to deploying PLEXOS for the 2022 IRP.
- Replacing PLEXOS at this stage is disruptive, though potentially possible, to the timely completion of the 2022 IRP.
- In replacing PLEXOS, DESC needs a tool that can integrate similar key functions:
  - Capacity expansion at the market and portfolio level
  - Portfolio dispatch, cost, and performance reporting
  - Doesn't require DESC to interpolate any data for analysis

In order to justify switching away from PLEXOS, it is not enough that another model is "just as good as" PLEXOS, it needs to perform materially better on a key capability or criteria – and both of the following must be true:

1. PLEXOS has a real shortcoming or is incapable of meeting the model criteria
2. The alternative performs materially better in this category – while also meeting all other requirements

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Overview of Methodology

1. CRA interviewed DESC to understand how they plan to use a capacity expansion model
2. CRA solicited feedback from Stakeholders on new models and capabilities to review
3. CRA performed an initial screening to determine which of these proposed models were capable of replacing PLEXOS for DESC's 2022 IRP
   - In the initial screening, CRA relied on its own experience, literature review, and the feedback from stakeholders to perform a high level evaluation of the proposed models and create a short-list for more detailed evaluation
   - Models fail the initial screen if:
     - They are not commercially available
     - They are not a single package capable of performing all functions that DESC requires
     - Model outputs require interpolation of cost data for IRP analysis
     - They clearly do not meet at least one of the Commission criteria
4. Models that achieve this minimum standard are candidates and further evaluated against both Commission criteria and Stakeholder criteria
   - CRA interview vendors for each candidate model to better understand capabilities, transparency, & licensing

CRA's understanding of DESC plans to use PLEXOS in the 2022 IRP

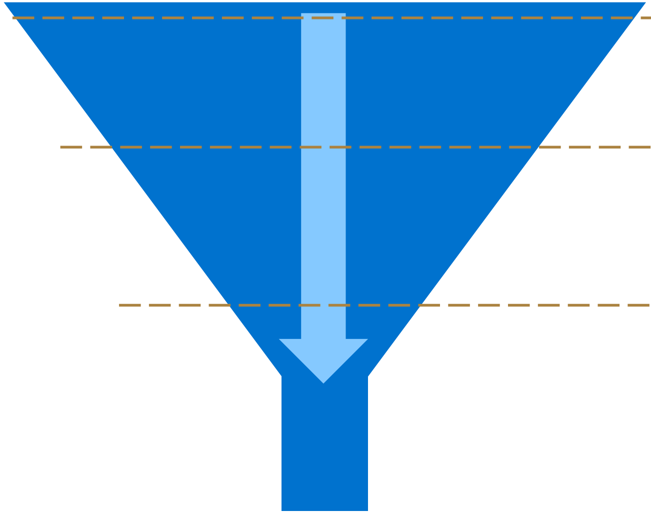
DESC plans to use PLEXOS across related planning functions to maintain consistency between potential conditions in the broader market and the impacts on DESC ratepayers when performing its IRP

PLEXOS includes three main modules (ST Plan, MT Plan, and LT Plan) which provide long term resource optimization and well as production cost modeling using a common set of assumptions

1. Capacity Expansion & Portfolio Optimization
   - PLEXOS will be used to model different long-term scenarios a system DRR and an optimal capacity expansion plan that considers different retirement and replacement options for each scenario
2. Portfolio Dispatch & Risk Analysis
   - PLEXOS will be used to dispatch the DESC system against different scenarios and uncertainties and report the total fuel consumption, emissions, and operating costs for financial and risk analysis

CRA reviewed all models discussed in Session I and proposed by Stakeholders in this shortlisting process

16 models proposed



Screen 1: Is the model commercially available (e.g., can DESC staff run the model)?

Screen 2: Does it perform the key functions as a single package?
(1) capacity expansion & portfolio optimization
(2) portfolio dispatch and risk analysis
(3) reports every forecast year (no interpolation)

Screen 3: Is it capable of meeting all the Commission Criteria?

4 Candidate models for further consideration:
AURORA, PowerSIMM, EnCompass, E7

Shortlisting exercise focused on Commission-defined capabilities

Added initial screens, if these fail then no further assessment is needed

Model	Commercially Available?	Single Package w/ all Functions?	Model Functionality and Capabilities						
			Portfolio Capacity Expansion / Retirement Optimization	*Emission Limit Constraints*	*Chronological Dispatch and Optimization*	*Long-term Cost Accounting and End Effects*	*Advanced Storage Logic – Pairing, Daily/ Seasonal Cycling*	*Operational Constraints – Start Costs, Min up/down Times*	*Flexible, Time-indexed Cost and Growth Escalators*
PLEXOS	YES	YES	YES	YES	YES	YES	YES	YES	YES
Aurora (1)	YES	YES	YES	YES	YES	YES	YES	YES	YES
PowerSIMM (2)	YES	YES	YES	YES	YES	YES	YES	YES	YES
EGEAS	YES	YES	YES	YES	NO	Solves to load duration curve			
SERVM	YES	NO	NO	Does not optimize capacity expansion					
EnCompass (3)	YES	YES	YES	YES	YES	YES	YES	YES	YES
Capacity Expansion[1]	YES	NO	Simplified dispatch requires second model for dispatch and risk analysis						
PROMOD	YES	NO	NO	Does not optimize capacity expansion – considered as part of E7 package					
PROSYM / PAR	NO		No longer being sold by ABB						
UPLAN	YES	NO	NO	Does not optimize capacity expansion					
WIS:dom-P	YES	NO	Use of investment periods requires interpolation						
GridPath	YES	NO	Use of investment periods requires interpolation						
E7 (4)	YES	YES	YES	YES	YES	YES	YES	YES	YES
RPM	NO		Not commercially licensed (NREL)						
ReSolve	YES	NO	Simplified dispatch requires second model for dispatch and risk analysis						
GridSim	NO		Not commercially licensed (Brattle)						

Transparency & Stakeholder Criteria considered in next step

Models suggested by Stakeholders

1 Previously Strategist, this model is no longer offered by ABB and has been replaced by Capacity Expansion

Approach to Detailed Evaluation of Short-listed “Candidates”

General Approach:

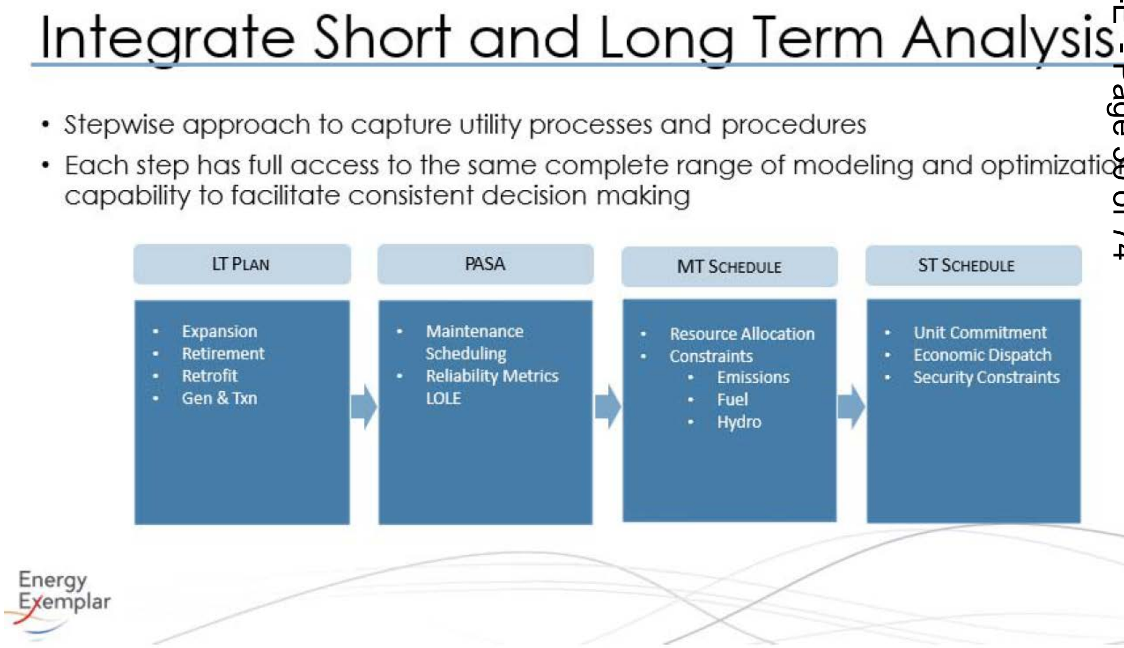
1. CRA outreach to vendors for modeling documentation
2. CRA review of model documentation & question development
3. Interview with model vendor to answer any questions
4. Evaluation of models against criteria

CRA evaluated models against two “scorecards”

- Commission criteria are “need-to-haves”
  - All models met these minimum criteria, but any major limitations or stand-outs are reflected
- Stakeholder criteria are “nice-to-haves”
  - Used to distinguish between models that score similarly on commission criteria

Overview of PLEXOS for Resource / Capacity Optimization

- PLEXOS owned by Energy Exemplar uses mathematical optimization techniques to create a simulation of the power sector
- PLEXOs includes four modules that rely on a common set of data to perform the least cost capacity expansion and portfolio optimization process
- LT capacity expansion typically runs in about 3 hours (highly variable dependent on inputs).
- Two staged solution process used to ensure efficient dispatch (LT module defines mix, then ST module determines production costs and dispatch).
- Verified capability to optimally retire units and replace with efficient mix of resource additions.
- Can consider demand side options as resources to be evaluated against supply side resources.
- Flexible regarding input escalation rates and inputs.

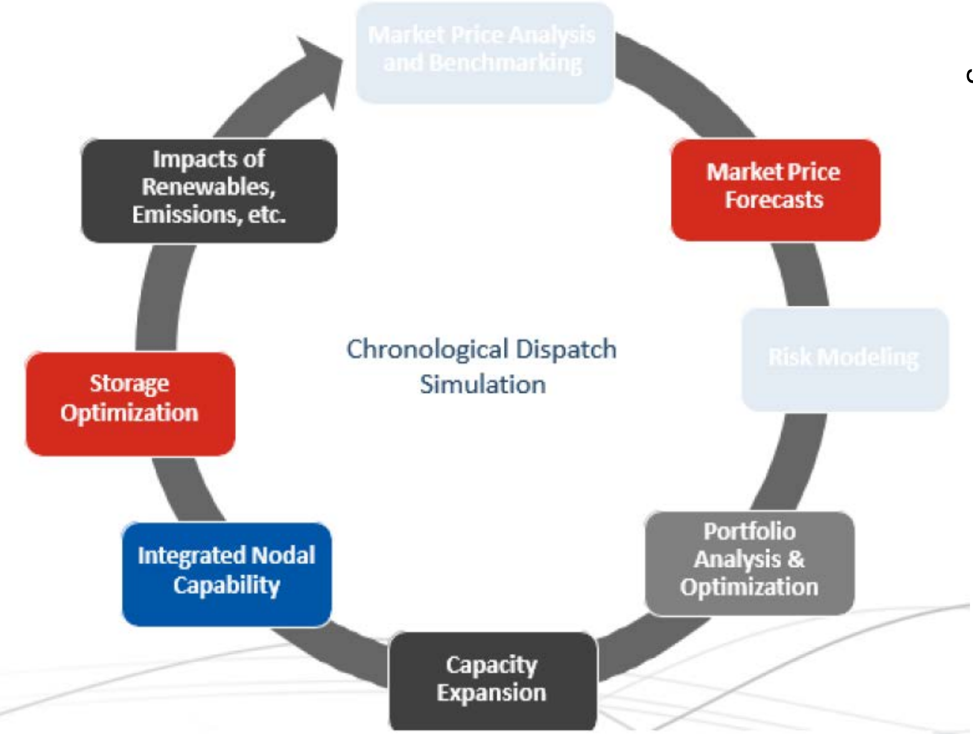


AURORA Overview

- AURORA is an electric sector model offered by Energy Exemplar, with zonal and nodal capabilities, key functions include:
  - Generation Planning / Budgeting
  - Market Assessment & Strategy
  - Transmission Planning
  - Trading support (LMP / FTR)

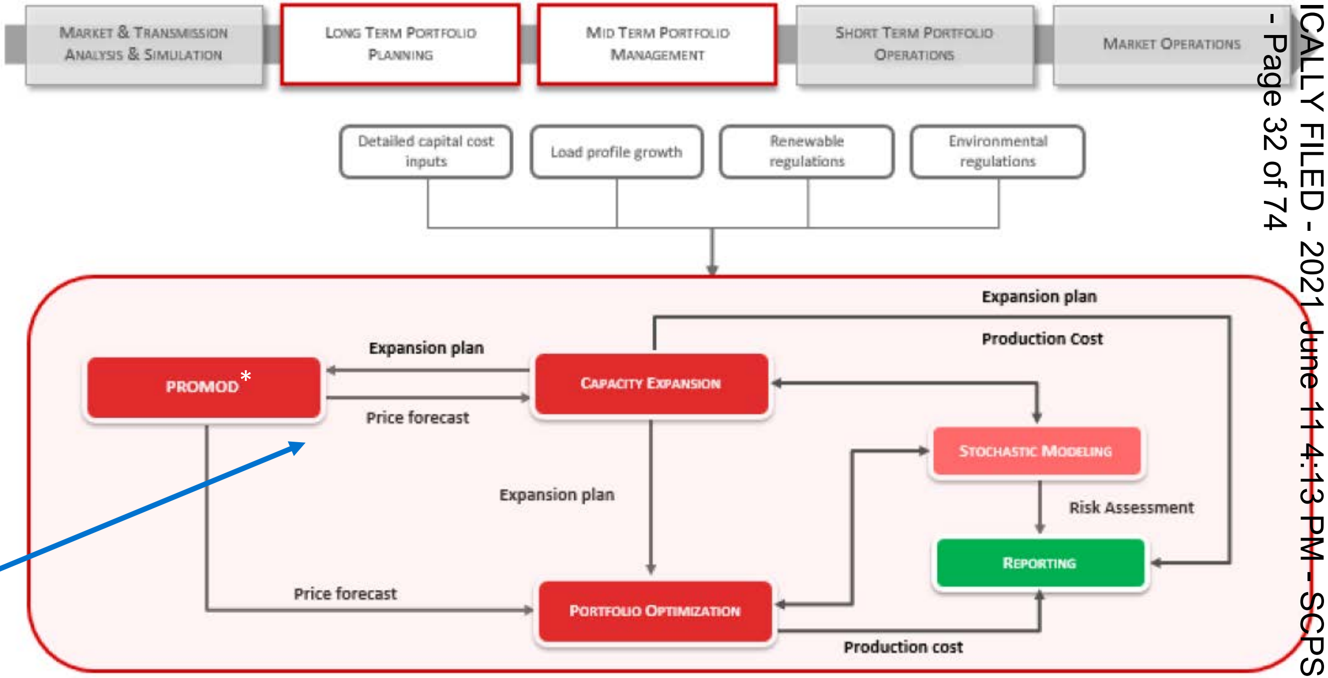
- LTCE function employs value based, iterative logic that can build to minimize costs or maximize value
  - Selects from new builds or retrofit and retirement options
  - Chronological valuation of renewable and conservation resources
  - Reflects Emission / RPS requirements

- Portfolio optimization function allows for specific RPS targets and other upper / lower bound constraints
  - Includes stochastic functionality
  - Simulation speed touted as selling point



Overview of ABB E7 Resource Planning Solution

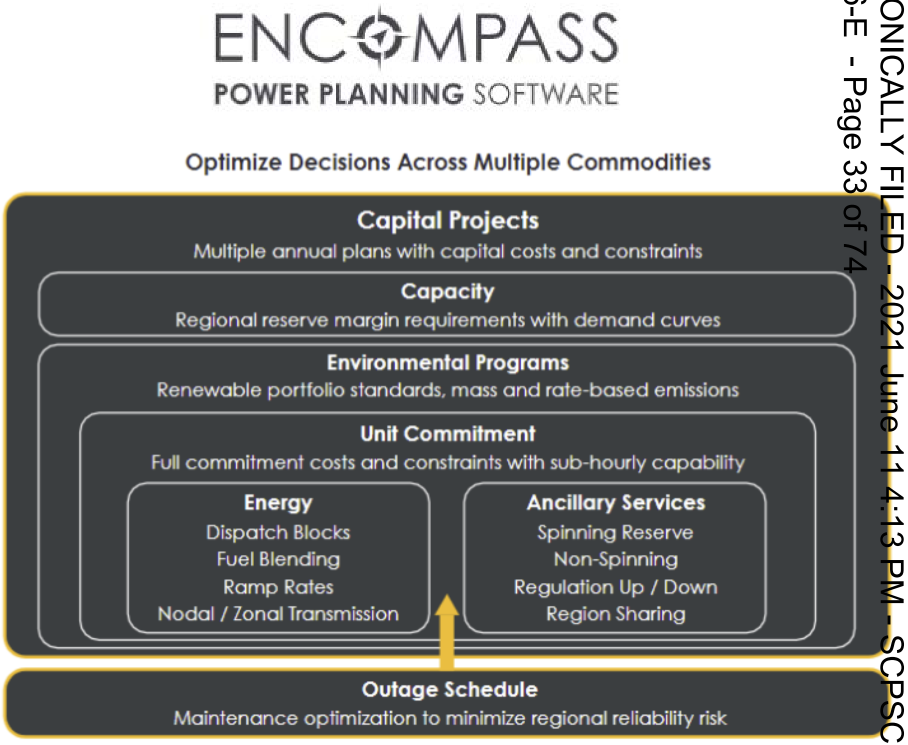
- E7 is a interface / platform which integrates other modules developed by ABB Power Systems
- Modules can be run together using a common set of inputs
- When used as a package, E7 modules perform all functions required by the Commission
  - PROMOD and Capacity Expansion both needed, others may be added to support specific functions



* E7 works with PROMOD HD (not PROMOD IV which many ISO's use)

EnCompass Overview

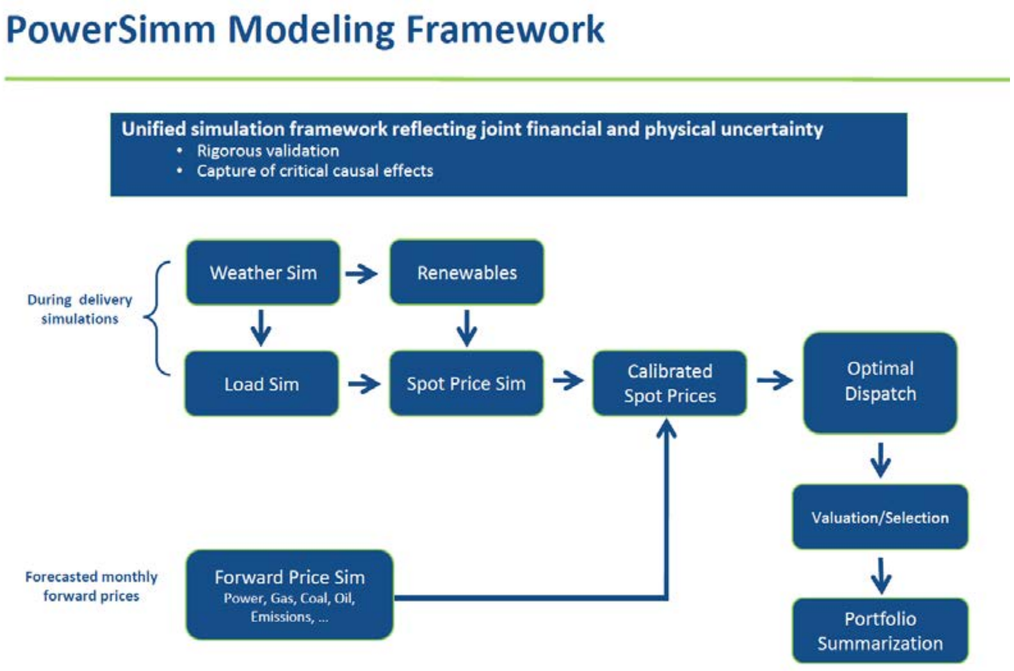
- EnCompass is a power-sector model developed by Anchor Power Solutions that allows for short-, medium-, and long-term resource planning studies and portfolio optimization
- Model can optimize under different emissions regimes and used to evaluate energy price, congestion, ancillary services and other system outcomes
- A common set of data drives different planning functions that can optimize individual utilities or portfolios and maintains chronology between studies of different types
- Allows for scenario-driven analysis as well as stochastic analysis of uncertainty



Dominion Energy

PowerSIMM Overview

- PowerSIMM is a suite of production cost and analytics tools offered by Ascend Analytics that works by leveraging Monte Carlo simulation to forecast a large number of market outcomes
  - PowerSIMM process of using statistical distributions and randomized draws to simulate key input variables, the foremost of which is weather. Other stochastic variables include fuel prices, power prices, renewable generation, and outages.
- PowerSIMM includes a long term capacity expansion module that selects the least cost and least risky plan over the body of simulated outcomes, as opposed to the lowest cost in a single scenario



Commission Scorecard

Model	Model Functionality and Capabilities							Model Transparency		
	Portfolio Capacity Expansion / Retirement Optimization	*Emission Limit Constraints*	*Chronological Dispatch and Optimization*	*Long-term Cost Accounting and End Effects*	*Advanced Storage Logic – Pairing, Daily/ Seasonal Cycling*	*Operational Constraints – Start Costs, Min up/down Times*	*Flexible, Time-indexed Cost and Growth Escalators*	*Manual Availability*	*Third-party License at Reasonable Cost*	*Easy Access to Input/ Outputs*
PLEXOS	Retirements optimized to chosen scenario, reflects unit costs of different timing	Mass, rate, RPS, tax, ACP all allowed	Chronological solver available in every module, sub-hourly function	Reflects levelized long – term costs and other end effects	User defines period of storage optimization for unit types, pairing possible	Operational and reserve constraints reflected in model	Highly flexible, negative rates and inflection points supported	Manual available to Licensed users	6-month, project-based license available	All inputs, outputs, and settings can be exported
Aurora			Chronological evaluation in LTCE and dispatch functions, sub-hourly function				Custom time series values available including negative and non-linear inputs	Licensed users have access to detailed help files		Model can export all inputs and outputs
E7 (ABB)			Capacity Expansion function simplifies chronology, PROMOD runs chronologically				Inputs indexed to time, highly flexible	Available with NDA	3-month "engagement" licenses offered, each module has a separate license	Inputs, outputs, and settings exportable in text or excel
EnCompass			Chronological solver available in every module, sub-hourly function	Estimates long-term economic carrying charge & Revenue Requirement					Monthly, project-based license available	All inputs, outputs, and settings can be exported
PowerSIMM	Retirements optimized to set of stochastic outcomes (can also run single iteration)		Model solves in chronological format, Capacity Expansion function uses monthly prices	Long terms levelized costs can be input by the user			Time-series of stochastic variables generated by model, other parameters can be indexed to time	Licensed users have access to help files and wiki	Discounted "dashboard" license available	Model can export all inputs and outputs

*Note that companion financial models are often used with models for full revenue requirement accounting

Takeaways from Commission Scorecard

- Deeper dive indicates no major "fails" for candidate models
  - PLEXOS meets all requirements laid out by the Commission
- Candidate models perform similarly across most criteria
  - Expected since all met "minimum requirements"
  - All allow project-based licenses for intervenors
  - Simplified chronology for capacity expansion function is used across all as a practical matter
    - While models may have settings that allow for fully chronological capacity expansion runs, the timing and computation requirements of running a fully chronological study over 20+ years are impractical so they employ approaches to reduce the size of the problem
- Some differences exist
  - PowerSIMM relies on a Monte Carlo approach that simulates a large number of outcomes and then finds an optimal resource plan based on the distribution of outcomes
  - EnCompass includes more detailed treatment of long term resource costs
  - Some models rely on a set of help files rather than a formal manual that can be shared with intervenors

Stakeholder Scorecard

Model	Model Functionality and Capabilities							
	Vendor supports software & provides training	*Ability to dispatch to load*	*Model allows for granular / diverse renewables*	*Stochastic functions are customizable*	*Can optimize relevant service territory*	*Reasonable run times*	*Vendor not required to run model*	*License supports intervenor use in DESC IRP*
PLEXOS	Manual updated regularly and website training modules available	Model is capable of dispatching to load and price	Unit types allow for different cost and performance assumptions	Stochastic draws can be specified by user, accepts many variables	Model is capable of optimizing as a balancing authority	Model settings, sampling, and chronology can be simplified to reduce run time	Users can run model and adjust all settings without vendor	Project-based license allows user to specify inputs, allows for consultants
Aurora	Updated regularly, users have access to detailed help files, and training videos available	Core LTCE dispatches against load, Portfolio model may dispatch to load or price	Unlimited definition of supply alternatives, including vintage technologies	Stochastic draws can be specified by user, accepts many variables	Model is capable of optimizing as a balancing authority	Vendor describes model as "Exceptionally fast" but larger studies may take longer	Users can run model and adjust all settings without vendor	Project-based license allows user to specify inputs, includes solver, allows for consultants
E7 (ABB)	Modules updated regularly, but PROMOD HD does not include simulation ready data 3-day training required for new users	Model can dispatch to load, minimize cost of serving load	Unit types allow for different cost and performance assumptions	Stochastic draws and seed can be specified by user, any time-indexed variable can be used	Model is capable of optimizing as a balancing authority	CE module simplifies chronology which can shorten run times	Users can run model and adjust all settings without vendor	Individual license for each product, project-based license includes solver, allows for consultants
EnCompass	Updated regularly manual, help document and training videos available	Model is capable of dispatching to load and price	Unit types allow for different cost, performance, and financial assumptions	Stochastic draws can be specified by user, accepts many variables	Model is capable of optimizing as a balancing authority	Model settings, sampling, and chronology can be simplified to reduce run time	Users can run model and adjust all settings without vendor	Project-based license includes solver, allows for consultants
PowerSIMM	Model is updated regularly and help files / wiki available	Planning model solves to long-term price forecast, but model can dispatch to load	Model allows detailed simulation of renewable outputs and different types are allowed	User can define number of "Simreps" or stochastic draws	Model is capable of optimizing as a balancing authority	Stochastic approach is computationally intensive for longer studies	User can adjust all settings but vendor help may be needed to ensure sensible results	"Dashboard" access allows user to audit inputs and outputs, allows for consultants

Dominion Energy

Takeaways from Stakeholder Scorecard

- No major functional “fails” for PLEXOS
  - PLEXOS is able to optimize retrofits and retirement of units as part of capacity expansion function, and different unit retirement dates can reflect different retirement costs
  - PLEXOS is able to able to optimize to load and balance individual service territories
  - PLEXOS allows for different units of the same type (e.g., solar) with unique cost and performance characteristics to reflect geographic diversity
  - PLEXOS allows the user to customize stochastic variables, define the sampling type, and set number of draws

- Transparency and licensing support use case
  - PLEXOS vendor offers a discounted project-based license that intervenors or their consultants can use to evaluate all inputs, outputs and settings in model software
    - Includes options for automated training material and live training support
    - Format has been successfully deployed across multiple states and IRP proceedings
  - For Stakeholders not interested in licensing PLEXOS, all inputs, outputs, and settings can be exported for review

Example Uses of Energy Exemplar Intervenor Licenses – PacifiCorp, Idaho Power

PacifiCorp's 2021 IRP (PLEXOS)

- PacifiCorp collaborated with intervenors to gather direct feedback on modeling inputs to assist in complying with their local clean energy regulations. Of the runs included in this feedback process, intervenors requested that the PacifiCorp IRP team indicate what recommended cases and sensitivities they are adapting, and provide the rationale for which runs they chose to exclude.
- PacifiCorp shares all data input files when the IRP is filed. Intervenors can view the inputs, outputs, and internal changes made by PacifiCorp in their modeling process

Idaho Power 2019 Modified IRP (AURORA)

- Intervenors expressed concerns regarding the lack of DR programs in an amended 2019 IRP. The intervenors, given access to model inputs, recommended modeling adjustments.
- The Intervenors motivated the utility to model DR as a resource to meet winter peak loads and explore winter DR programs.
- Idaho Power facilitated continued engagement with the intervenors on these changes to modeling inputs and parameters.

Sources: PacifiCorp Stakeholder Feedback Form June 26, 2020, Oregon Citizen's Utilities Board Final Comments

Example of PLEXOS Intervenor License – American Electric Power

- AEP utilities SWEPCO and I&M Power engage with stakeholders in advisory processes
- AEP used PLEXOS for their IRP processes which allows intervenors to edit all inputs, and examine inputs and outputs of their modeling. Intervenors are also able to view all of the settings selected for modeling.
- How stakeholders engaged with the utilities using their PLEXOS intervenor licenses:
  - **SWEPCO:** provided their stakeholders with preliminary IRP modeling results a month before IRP filing, followed by a webinar to discuss the results. The Stakeholder committee developed a list of requests and modifications and submitted additional sensitivity runs to which SWEPCO responded in writing.
  - **Indiana Michigan Power:** gathered suggestions on modeling factors such as: modeling CHP resources, lowering solar cost options by extending the ITC, adding a carbon free portfolio model run, evaluating the closing of existing fossil-fuel resources earlier than their estimated useful life, among others. I&M respond to all requests in writing. The feedback was used to modify analysis.

Discussion - Please "Raise Hand" in the Chat

DESC IRP Stakeholder Advisory Group Meeting #2

III. Review Modified 2020 IRP Filing

III. Review Modified 2020 IRP Filing

- Review: Act No. 62 Evaluation Factors
- Preferred Plan Selection Criteria
- *Discussion*

Act No. 62 - Most Reasonable & Prudent Conditions

Commission is directed to consider…whether the IRP appropriately balances seven factors

- **RESOURCE ADEQUACY***: Able to serve anticipated peak load & planning reserve margins
- **COMPLIANCE***: Compliance with applicable state and federal environmental regulations
- **COST**: Consumer affordability and least cost
- **RELIABILITY**: Power supply reliability
- **COMMODITY**: Commodity price risks
- **DIVERSITY**: Diversity of generation supply
- **OTHER**: Other foreseeable conditions that the Commission determines to be for the public interest

Additional Order Requirements:

- Evaluate plans against all scenarios
- Evaluate "Cost Range" (COSTS)
- Evaluate "Minimax Regret" (PLAN DIVERSITY)

*All plans meet **Resource Adequacy** & **Compliance** factors

Dominion Energy

Preferred Plan Criteria

DESC Metrics for comparative evaluation

✓ RESOURCE ADEQUACY

✓ COMPLIANCE

	40-yr NPV	CO2	Clean Energy	Fuel Costs	Diversity	Reliability	Minimax Regret	Cost Range
✓ COST	✓			✓				
✓ RELIABILITY						✓		
✓ COMMODITY				✓				✓*
✓ DIVERSITY					✓		✓*	
✓ OTHER		✓	✓					

*Per Sercy, Commission agreed: "appropriate means" for considering commodity price risk & "diversity of generation supply" (must include)

Preferred Plan Criteria

- Levelized Cost
  - Comprehensive measure of the relative costs to customers of each of the fourteen resource plans over the 40-year period from 2020-2059
- CO2 Emissions
  - The performance of all resource plans to the CO_2 Emissions as forecasted at the end of 40-year period ending in 2049
- Clean Energy
  - Compares the resources plans based on how much energy they produced with non-emitting generation over each five-year period during the forty-year planning horizon, 2020-2049
- Fuel Cost Resiliency
  - Fuel cost incurred under each of the resource plans was calculated under each of the 27 sensitivities modeled
- Generation Diversity
  - Ranks the generation diversity of each resource plan according to the percentage that the generation mix it creates is concentrated in any one type of generation asset

Preferred Plan Criteria

- Reliability Factors
  - Able to generate or become a load, shift energy, and complement renewables
    - Energy Storage - The units have the ability to shift available energy from low demand periods to high demand periods which aids reliability.
    - Limited Energy Source - The unit is able to function as a source of energy whose output normalizes to 16 hours/day of full load production but has limited abilities to replace 24-hour resources.
    - Dispatchability - The unit will respond to directives from system operators regarding its status, output, and timing. The Dispatchability of intermittent resources is limited and so their score is subject to a deduction. They cannot be counted as firm and require additional reserves.
    - Operational Flexibility - The unit is able to cycle and ramp up and down with little or no adverse impact on fuel costs or physical damage to the unit. Deductions are made if the units have a minimum operating load below which it cannot be dispatched.
    - Coincident Peak Output - The unit has the ability to provide energy and capacity to meet customer requirements during the winter peak demand period.
    - AGC - The unit has the ability to be placed on Automatic Generation Control allowing its output to be ramped up or down automatically to respond immediately to changes on the system.

Preferred Plan Criteria

- Reliability Factors (continued)
  - Able to generate or become a load, shift energy, and complement renewables
    - Fast Start - The unit can respond from an offline condition and produce full load in less than 10 minutes.
    - Inertia (non-inverter) - The unit operates using large rotating machinery (turbines, shafts, stators, exciters, etc.) that provide an inertial energy reservoir or a sink to stabilize the system. The rotation of this mass of machinery (inertia) provides frequency support.
    - VAR support - The unit can be used to send VARs out onto the system or consume excess VARs and so can be used to control voltage
    - Geographic Diversity - The unit can be located in diverse locations and is not restricted by fuel infrastructure.
    - Proximity to Load - The unit has a compact footprint and low impact outside of the fence. It can often be sited near load centers.
    - Synchronous Condensing - The unit can provide voltage support (VARS) even when not producing energy (synchronous condensing).
    - Black Start - The unit can be used in the first step to system restoration after an outage.

Preferred Plan Criteria

- Mini-Max Regret Analysis
  - Evaluates each resource plan against the lowest cost plan in each scenario and calculates the difference in the 40-year levelized NPV between the plans
- Cost Range Analysis
  - Evaluates the variation in the 40-year levelized NPV for each plan across the 27 scenarios that were modeled

Questions? Please use the Chat function

DESC IRP Stakeholder Advisory Group Meeting #2

IV. 2021 IRP Update Scenario Modeling and Inputs

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IV. 2021 IRP Update Scenario Modeling and Inputs

- Gas Price Assumptions
  - 2021 IRP Update: Production cost modeling using latest AEO low, reference, and high gas prices
- DSM Assumptions
  - DESC achieves 1% savings in retail sales in years 2022, 2023 and 2024
- CO2 Price Assumptions
  - Re-run production cost model 2020 Modified CO_2 price assumptions
- *Discussion*

Questions? Please use the Chat function

DESC IRP Stakeholder Advisory Group Meeting #2

V. 2021 IRP Update Resource Plan Modeling & Inputs

Dominion Energy®

V. 2021 IRP Update Resource Plan Modeling & Inputs

- New Resource Capital Costs & Escalation Rates
- PPA Costs and Assumptions
- Mini-Max Regret Vs. Other Risk Metrics
- Modeling Existing Candidate Resource Plans
- Model Additional Low Carbon Plan
- Consider limiting scenarios/production cost model runs
- *Discussion*

MiniMax vs. Other Risk Metrics

- Definition of concept and what it measures
  - MiniMax measures regret as the difference between a portfolio's cost and the lowest cost option within the same scenario
  - MiniMax regret score may be high if one scenario is very different than others:
    - Your lowest cost outcome is very low
    - Your highest cost outcomes is very expensive

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Investment A	$ 100 B	$120 B	$125 B	$140 B
Investment B	$103 B	$123 B	$127 B	$131 B
Investment C	$110 B	$125 B	$128 B	$130 B

Red cells are lowest cost outcome in each scenario

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Maximum Regret of Each Investment
Investment A	$ 0 B	$0 B	$0 B	$10 B	$10 B
Investment B	$3 B	$3 B	$2 B	$1 B	$3 B
Investment C	$10 B	$5 B	$3 B	$0 B	$10 B

Maximum of the difference between portfolio and least cost option across scenarios

Minimizing the Maximum Regret

Step 1: Calculate the net present value of total system cost (net present value revenue requirement) for each investment option or investment portfolio across all scenarios.

Step 2: Create a matrix of total costs for each investment option in every scenario. Determine the least-cost investment option in each scenario.

Step 3: Calculate a regret score for each investment option across all scenarios by subtracting the least-cost option from each investment option within each scenario. Create a matrix of regret scores.

Step 4: Determine the maximum regret of each investment option by selecting the maximum regret score for each investment option across all scenarios. Determine the investment option with the lowest maximum regret. This option minimizes the maximum forecast regret.

Risk Analysis Examples

Tennessee Valley Authority 2019 IRP

Used **Monte Carlo distribution** to generate 120 stochastic iterations for each of the scenario / strategy combination for 6 scenario groups that exhibited common characteristics

- **Risk metrics:**
  1. Risk / Benefit Ratio: Area under the plan cost distribution curve between P(95) and expected value divided by the area between expected value and P(5).
  2. Risk Exposure: The point on the plan cost distribution below which the likely plan costs will fall 95% of the time.

- Strategies that behaved in a similar manner in most scenarios were considered to be "robust" – i.e., more flexible, less risky over the long-term, conversely, strategies that behaved differently or poorly were more risky with a higher probability for future regret

Duke Energy Carolinas 2020 IRP

- DEC developed six portfolios and evaluated them a matrix of nine carbon and fuel cost scenarios that represent 3 different fuel price and CO_2 emissions price trajectories.
- Cost risk was estimated using the expected present value of rate requirement (PVRR) over 30 years (through 2050) and DEC evaluated the **Min, Median, and Max** of the **PVRR** outcomes across each portfolio in the nine carbon and fuel cost scenarios.
  - DEC selects a robust plan that minimizes the PVRR to customers while meeting reliability targets and is considered environmentally sound. Finding these least cost portfolios meet the current IRP rules and regulations currently in place in NC and SC.

Sources: Tennessee Valley Authority 2019 IRP, Duke Energy 2020 IRP

Output from 2021 IRP Update will be similar to DEC

1. What alternative measures of price risk that can be used in addition to MiniMax using expected outputs from 2021 Update?
   - Worst outcome for a portfolio across all scenarios
   - Range (within portfolio – across scenario)
   - Difference between mean and worst outcome across scenarios

2. What other risk metrics can be used outside of price risk?
   - Reliance on purchases or imports
   - Reliance on one technology can add more risk to the portfolio

202I IRP Update

Med DSM

Low DSM

High DSM

Gas View	CO2 Price
Low	$0 / ton
Low	$12 / ton
Low	$35 / ton
Base	$0 / ton
Base	$12 / ton
Base	$35 / ton
High	$0 / ton
High	$12 / ton
High	$35 / ton

Questions? Please use the Chat function

DESC IRP Stakeholder Advisory Group Meeting #2

VI. Retirement Analysis

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VI. Retirement Analysis

- Review: Short-Term Action Plan
- Status of DESC's Retirement Analysis and Transmission Impact Analysis Request
- Request Letter from Resource Planning to Transmission Planning (provided on DESC-CRA website)

> 5. It is reasonable for the Commission to require DESC to perform a comprehensive coal retirement analysis to inform development of its 2022 IRP Update and its 2023 IRP and to solicit parties' recommendations on guidelines for performing this analysis through the ongoing IRP Stakeholder Process. Upon completion of the coal retirement study – and targeting the 2023 IRP - DESC shall begin modeling coal retirement as an option in the various scenarios.

Short-Term Action Plan – Generation Retirement Planning

- Generally, each retirement study will:
  - Identify decommissioning and site restoration costs
  - Identify replacement generation and operating parameters
  - Determine scope and cost of transmission investments
  - Make retirement recommendation
  - Implement retirement decision
  - Update planning models to reflect retirement decision
  - Commence a retirement study for the next candidate
- These steps will take months and years and each study will inform the next
  - Order sequence to be followed: Wateree 1 & 2, Williams, then Cope
- Studies may be completed concurrently with Wateree and Williams
  - Urquhart 3
  - McMeekin 1 & 2
  - Hagood ICTs

Transmission Impact Analysis Request

- DESC Transmission Planning is independent of DESC Generation and Resource Planning
  - FERC regulated
- DESC Transmission to quantify the effects of removing Wateree Units 1 & 2 from service
- The letter requests evaluation of the following scenarios
  - Case 1: Replace with Purchased Power (off-system generator-firm capacity-backed scheduled energy)
  - Case 2: Repurpose the site by adding battery storage and utility-owned flexible PV solar. Supplement with purchased power and a possible 117MW CT at Bushy Park if needed.
  - Case 3: Re-power the site with a 684MW 1X1 CC two years after coal plant retirement
  - Case 4: Retire Wateree site; build a 684MW 1X1 CC immediately at the Parr site
  - Case 5: Retire Wateree site; build a 684MW 1X1 CC immediately at the Canadys site
  - Case 6: Retire Wateree site; build a 684MW 1X1 CC immediately at the Cope site
  - Case 7: Retire Wateree site; build a 684MW 1X1 CC immediately at the Jasper site
- Transmission costs to be estimated (Any site other than Wateree requires an Interconnection Study)
  - Grid impact modification due to closure
  - I.C. cost of new generator

Transmission Impact Analysis Request

- DESC Transmission Planning is independent of DESC Generation and Resource Planning

DESC IRP Stakeholder Advisory Group Meeting #2

VII. Winter Capacity Value of Solar for the IRP

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VII. Solar Winter Capacity

- 2021 IRP Update Requirements

> Prospectively, Dominion shall work with stakeholders regarding fair inclusion of solar PV's winter capacity value in the 2021 and 2022 IRP Updates. This should be a good-faith attempt to reach a mutually agreeable value to propose for assignment for PV capacity value in the winter.

- Reliability Measure vs. Resource Compensation
  - Avoided Cost compensation value of solar capacity
  - **Winter PV Solar incremental capacity contribution used in the IRP**
  - Operational capacity value used to maintain reliable operation of the system

VII. Solar Winter Capacity

- **IRP Policy for winter capacity value of PV Solar**
  - IRP Reserve Margin capacity contribution of solar
    - Use 11.8% ELCC value per Order 2020-832 (IRP Order)
      - This is not appropriate for IRP
    - Calculated to be 46% in the summer up to 1000 MW installed
      - ELCC value of 4.25% for incremental solar >973 MW
    - Calculated to approach zero in the winter and decreasing for additional PV solar

VII. Solar Winter Capacity

- Homework
  - Stakeholders may suggest winter PV solar capacity value to be used in the IRP or a method of study

DESC IRP Stakeholder Advisory Group Meeting #2

VIII. Homework for Session III and Discussion

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VII. Homework for Session III and Discussion

- Overview of Session II Homework
- *Discussion*
- *Recommend Risk Metrics that could be used in addition to Mini-Max Regret*
- *Recommend Coal Retirement Study considerations*
- *Recommend PV solar capacity consideration for rates and operations*

Setting expectations for Session III

- A Commission decision is expected on the 2020 Modified IRP after June 18th
- DESC proposed to convene Session III after this filing so that those comments and feedback can be addressed
- Session III content will still focus on 2021 IRP Update, but additional 2022+ topics can be raised

Week of:

Filing expected

S II → 4/19 → 4/26 → 5/3 → 5/10 → 5/17 → 5/24 → 5/31 → 6/7 → 6/14 → S III

Expected Topics for Session III

- Review Stakeholder feedback on process & the agenda suggestions
- Review feedback & update on analysis of 2021 IRP Update
- Review feedback & update on unit retirement analysis
- Review feedback & update on solar ELCC
- Review feedback & update on risk metrics

This is all follow up from Session II – what new topics do we want to discuss in Session III (if any)?

Tell us in the homework

Feedback Requested from Session II

- Review Advisory Group Minutes and Provide Comments
- Topical Feedback: What other issues should be addressed in Session III?
- Model Evaluation Feedback: Did we achieve consensus that PLEXOS performs all required functions?
- 2021 IRP Inputs: Is approach consistent with the order, are there any gaps?
- Risk Metrics Feedback: What metrics, in addition to Mini-Max, should DESC evaluate with the expected outputs?
- Retirement Analysis: What other considerations should DESC study in addition to transmission impacts?
- Solar Winter Capacity: Does DESC approach to measuring solar winter capacity contribution to the IRP make sense? What other approach or value would you recommend that DESC should adopt?

Questions? Please use the Chat function

Stakeholder Website Overview

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Stakeholder Meeting Materials posted here before or shortly after Working Group Sessions

FAQ

CRA International

Supplemental materials and QA support documents

Registered users can submit on-topic Questions to DESC

Published QA can be viewed by public

- Home
- Meeting Presentation and Materials
- Stakeholder Materials
- Register
- Submit Questions
- View Q & A
- DESC
- CRA International

About Dominion Energy South Carolina (DESC)

Dominion Energy South Carolina, Inc. (DESC), a public utility headquartered in Cayce, South Carolina, is a South Carolina corporation organized in 1924. DESC is a wholly-owned subsidiary of SCANA Corporation which, effective January 2019, is a wholly-owned subsidiary of Dominion Energy, Inc. DESC is engaged in the generation, transmission and distribution of electricity to approximately 753,000 customers in the central, southern and southwestern portions of South Carolina. Additionally, DESC sells natural gas to approximately 392,000 residential, commercial and industrial customers in South Carolina.

About the DESC IRP Stakeholder Working Group

The DESC IRP Stakeholder Working Group is a forum for DESC to solicit feedback directly from Stakeholders and build consensus around its IRP inputs and process. The Working Group Sessions and website will also provide Stakeholders with greater transparency into the technical modeling, input assumptions, and other factors that affect IRP results. DESC first implemented the IRP Stakeholder Group in 2021 as instructed by the South Carolina Public Service Commission.

About Charles River Associates (CRA)

DESC has partnered with Charles River Associates (CRA) to facilitate the IRP Stakeholder Group process. CRA will support DESC by coordinating meetings and materials, facilitating live Working Group Sessions, managing the Stakeholder Website, and assisting in the presentation of certain technical materials by providing perspectives on industry trends and best practices.

https://www.DESC-IRP-Stakeholder-Group.com

Email DESC-IRP-Group@crai.com with questions about the website or if you have content to share with the Stakeholder Group